THE KAMPTOZOAN *PEDICELLINA WHITELEGGII* JOHNSTON & WALKER, 1917 AND OTHER PEDICELLINIDS IN AUSTRALIA AND NEW ZEALAND

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Colonies of the kamptozoan (entoproct) *Pedicellina whiteleggii* are ubiquitous in the low intertidal and shallow subtidal zones of southern Australia and New Zealand. This species has been known under a variety of names, but can be distinguished from other pedicellinids by a suite of traits including longitudinal rows of conspicuous oblong cells on each tentacle, and a tall, narrow, particle-covered larva. *Pedicellina whiteleggii* is re-described and illustrated, and compared to all other pedicellinids reported from the waters around Australia and New Zealand. *P. whiteleggii* is a senior synonym of *P. hispida* and appears to be very similar to a number of other pedicellinids reported from these waters. However, *P. whiteleggii* is clearly distinct from three other species (*P. cernua*, *P. compacta* and *P. pyriformis*) known from Australia and New Zealand. The distribution of all these pedicellinids is discussed, and the importance of larval traits in kamptozoan taxonomy is emphasised.

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Members of the phylum Kamptozoa (Entoprocta) have rarely been studied in Australia and New Zealand. There are about twenty published reports on the kamptozoan fauna of these regions, and only a few of these have involved detailed taxonomic investigations (Hastings 1932, Johnston & Angel 1940, Ryland 1965).

Examination of museum collections revealed that only one pedicellinid species is common in the shallow waters of Australia and New Zealand. This species, *Pedicellina whiteleggii* Johnston & Walker, 1917, accounts for most of the museum specimens of *Pedicellina* from these waters. Published records and museum labels refer to these specimens under various names, but a suite of distinctive traits unites them. The ubiquitous nature of this species on these southern seashores was reinforced by field collections which indicated that colonies were present on many low intertidal and shallow subtidal substrata at all sites surveyed.

The purpose of this report is to unify these various specimens under one name, *Pedicellina whiteleggii*, and to justify this unification by describing the configuration of traits which characterises members of this species. This re–description of *P. whiteleggii* is followed by a brief review of all other pedicellinids known from Australia and New Zealand.

Materials And Methods

I examined all pedicellinid kamptozoans from localities around Australia and New Zealand deposited in the collections of the South Australian Museum (SAM), the Australian Museum (AM), the Museum of Victoria (NMV), the Museum of Tropical Queensland (MTQ), the Otago Museum (OM), the Portobello Marine Laboratory of the University of Otago (PML), and the British Natural History Museum (BMNH). Apparently no other museums contain collections of pedicellinids from Australia or New Zealand.

I collected live pedicellinids from the low intertidal or shallow subtidal zone at Fairlight, Port Jackson, New South Wales; Aldinga Reef, Gulf St. Vincent, South Australia; Pukerua Bay, North Island, New Zealand; and Aquarium Point, Otago Harbour, South Island, New Zealand. At each site, about one hour was devoted to collecting various living and non-living substrata from sheltered habitats under rocks or overhangs. These substrata were then examined under a stereomicroscope to detect pedicellinid colonies. This two step method of searching revealed that at each site pedicellinids were present on about 5–10% of the substrata collected.

Systematics

Phylum KAMPTOZOA Cori, 1929
(= Entoprocta Nitsche, 1870)

Order COLONIALES Emschermann, 1972

Sub-Order STOLONATA Emschermann, 1972

Family PEDICELLINIDAE Hincks, 1880

Genus ***Pedicellina*** Sars, 1835

Pedicellina whiteleggii Johnston & Walker, 1917 (Figs. 1–4).

? *Pedicellina sp.* MacGillivray, 1887: 221, no fig.

Pedicellina cernua (Pallas, 1774) *sensu* Whitelegge, 1889: 293, no fig.

Pedicellina whiteleggii Johnston & Walker, 1917: 60, fig. 14; Stach 1937: 374, no fig.

Pedicellina hirsuta Jullien, 1891 *sensu* Johnston & Angel, 1940: 227, figs. 38–42.

Pedicellina hispida (from New Zealand) Ryland, 1965: 197, fig. 5.

Gordon, 1972: 510, fig. 3.

non *Pedicellina cernua* (Pallas, 1774):57, fig. 10 in plate 4.

non *Pedicellina hirsuta* Jullien, 1891:13, no fig.

non *Pedicellina hispida* (from Europe) Ryland, 1965:200, fig. 8.

Etymology

Johnston & Walker (1917) named this species *Pedicellina whiteleggii* to honour Thomas Whitelegge, who had earlier collected colonies of the same species from the Port Jackson area. Whitelegge in 1883 became the first cataloguer of marine invertebrates at the Australian Musuem, and held that position until 1908. Whitelegge contributed greatly to the characterisation of the invertebrate fauna of the region, and was one of few Australians to report the presence of kamptozoan species on these seashores.

Type

Johnston & Walker provided two syntypes (SAM E942 and E943) of this species. I now designate SAM E942 as the lectotype; SAM E943 thereby becomes a paralectotype.

Type Locality

Johnston & Walker (1917) indicate that the types of *Pedicellina whiteleggii* were collected under stones in the intertidal zone at Port Jackson, NSW. They list both Middle Harbour and Watson's Bay as collection sites, and do not specify at which of these two localities the types were taken.

Material Examined

South Australia: Port Willunga, intertidal, 25.iii.1944, SAM L709; Outer Harbour, 0.5 m, R.G. Chittleborough, 2.v.1951, SAM L710; Point Turton Jetty, Yorke Peninsula, 3–4 m, K. Gowlett-Holmes, 2.iv.1994, SAM L711; Aldinga Reef, Gulf St. Vincent, 1–2 m, S.A. Shepherd & K. Wasson, 18.ii.1995, SAM L712; Aldinga Reef, Gulf St. Vincent, 1–2 m, S.A. Shepherd & K. Wasson, 18.ii.1995, personal collection of K. Wasson.

New South Wales: Port Jackson, intertidal, T. H. Johnston & M. J. Walker, SAM E942 & E943 (syntypes); Port Jackson, intertidal, T. H. Johnston & L. M. Angel, SAM BANZARE collection; Port Stephens, intertidal, T. H. Johnston, SAM L708; Port Stephens, intertidal, AM U672 & U673; Rose Bay, Port Jackson, AM U880; Long Reef, Sydney, intertidal, P.A. Hutchings & W.F. Ponder, 16.xi.1970, AM W22254; Port Kembla Harbour, 1 m, J. Watson, NMV F77075; Fairlight, Port Jackson, intertidal, K. Wasson & Aust. Mus. Party, 15.ii.1995, AM W22255.

Victoria: Little Henty Reef, near Apollo Bay, 2.5–8.0 m, C. Handreck, 5.ii.1994, NMV F76892.

North Island, New Zealand: Pukerua Bay, intertidal, S. O'Shea & K. Wasson, 28.i.1995, PML reference collection.

South Island, New Zealand: Cemetery Bay, Otago Peninsula, intertidal, E. Batham, 4.v.1961, PML reference collection (*P. hispida* holotype); Cemetery Bay, Otago Peninsula, intertidal, E. Batham, 4.v.1961, BMNH 1964.2.8.5 (*P. hispida* holotype); Cemetery Bay, Otago Peninsula, intertidal, E. Batham, 4.v.1961, BMNH 1964.2.8.25; Cemetery Bay, Otago Peninsula, intertidal, E. Batham, 10.xii.1962, OM Iv2010/A.64:9 (*P. hispida* paratype); Cemetery Bay, Otago Peninsula, intertidal, E. Batham, 10.xii.1962, BMNH 1964.2.8.6; Aquarium Point, Otago Peninsula, intertidal, M. Barker & K. Wasson, 4.ii.1995, PML reference collection; Aquarium Point, Otago Peninsula, intertidal, M. Barker & K. Wasson, 4.ii.1995, personal collection of K. Wasson.

Diagnosis

Stolon narrower than stalk; stolonic septa of variable thickness, but often very delicate; stalk quite thick, about three times as long as calyx;

stalk and calyx hispid; calyx wide and somewhat asymmetrical in side view; 16–36 tentacles, usually 20–24; tentacular membrane high; axial rows of large cells on abfrontal surface of tentacles, conspicuous as glistening bands in living zooids; larva small, tall and narrow, often densely coated with particles.

Description

Colony: A colony of *Pedicellina whiteleggii* resembles those of most other pedicellinids, with a network of stolons creeping on the substratum, from which the zooids arise at regular intervals (Fig. 1a). The stolons, stalks and calyces are translucent beige. New buds are formed at the

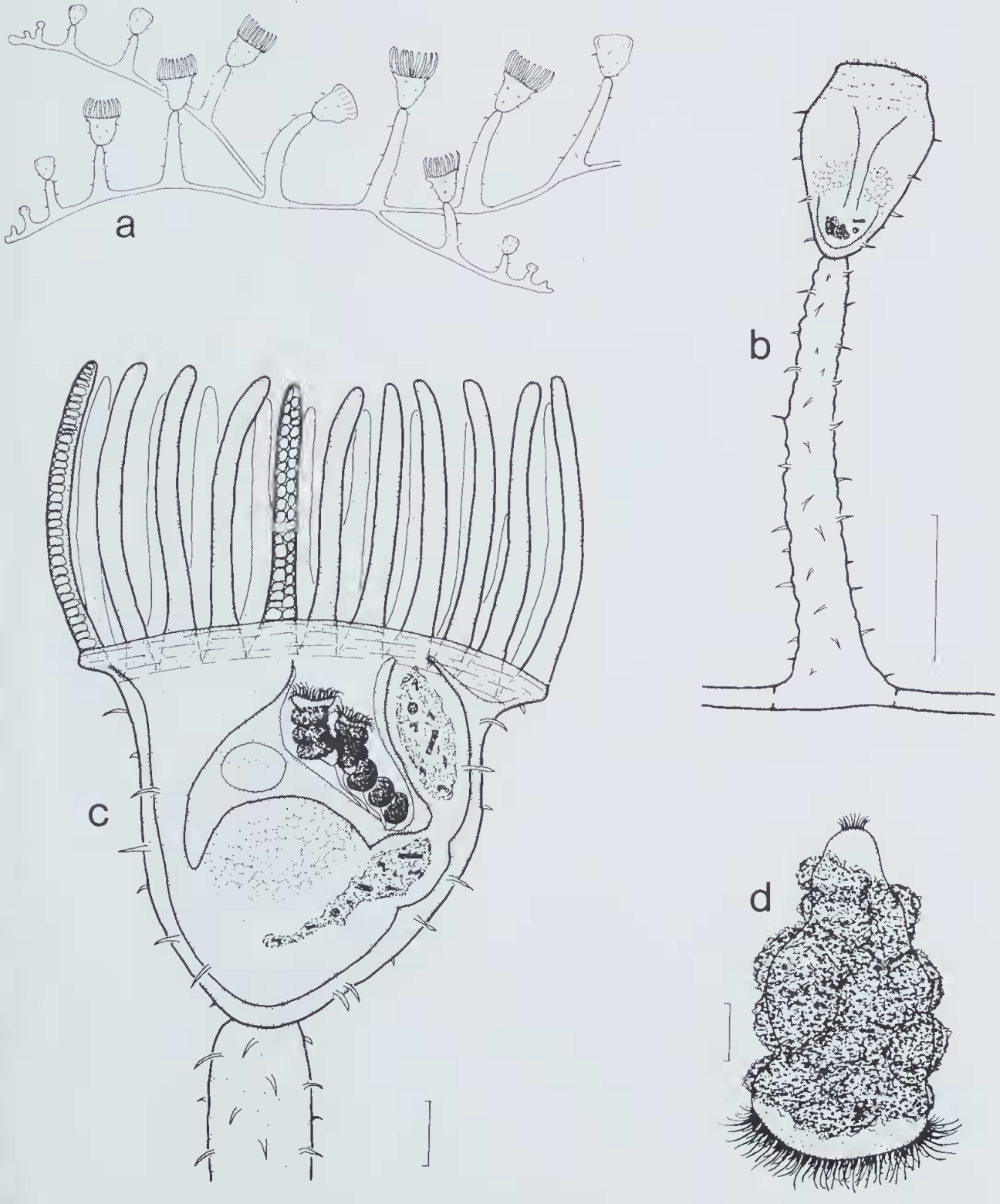

FIGURE 1. *Pedicellina whiteleggii*. **a**. part of a colony. Scale bar=1000 µm. **b**. zooid with a contracted male calyx in frontal view. Scale bar=500 µm. **c**. expanded female calyx in side view, with brooded larvae. The conspicuous rows of cells are shown on two tentacles only. Scale bar=100 µm. **d**. particle-coated larva. Scale bar=20 µm.

base of older zooids, and remain connected by a basal stolon. Calyces are deciduous, as in other stolonate kamptozoans, and at any time about 10% of the zooids in a colony are in the process of regenerating calyces that have been shed.

FIGURE 2. Two *Pedicellina whiteleggii* zooids (from Long Reef, NSW). Calyces are contracted and fixed, in side view. scale bar=200 µm.

Stolon: The stolon is always considerably narrower than the upright stalk (Table 1). The inter-zooidal stolonic distance varies within populations, but is often quite short, resulting in a high density of zooids (20–30 zooids/cm^2) on the substratum.

The septa which delineate stolon segments bearing zooids ("fertile" segments) from segments without zooids ("sterile" segments) are often unusually delicate and are sometimes so inconspicuous that they cannot be distinguished even by careful examination of thc appropriate portion of the stolon. The stolonic septa in *P. whiteleggii* appear to vary in thickness even within the same colony, ranging from distinct, fairly strong septa to extremely faint or even absent septa. This sort of septal variation is not typical of other pedicellinid species, in which the septa are either always present and conspicuous, as in *P. cernua*, or always absent, as in *P. pyriformis*.

Stalk: The stalk in *P. whiteleggii* is thicker and sturdier than those of many other pedicellinid species (Figs. 1b; 2). As in other pedicellinids, the stalk is highly muscular, and living colonies are characterised by the active bending motions of the zooids' stalks. Contracted zooids, which have been prcserved unrelaxed, sometimes appear to have annulate stalks.

Stalk length varies within a population, but typically the stalk is about 1.2–1.6 mm long, which is about three times as long as the calyx is high (Table 1). The stalk tapers in width from base to apex (Table 1). The stalk is invariably hispid, ornamented everywhere with cuticular spines (Figs. 1b; 2). The spines are often hook-shaped, down-curved with broad bases and narrow tips. Spine size and density vary within a population; some stalks may be sparsely covered with small spines while others are densely covered with long spines.

Calyx: The calyx is laterally compressed, being much wider in side view (Fig. 1c) than in anterior (Fig. 1b) or posterior view (Table 1). In side view, the calyx is broad and somewhat asymmetrical due to a slight aboral bulge. This bulge and the resulting asymmetry are variable within a population, and occasionally are rather pronounced.

The calyx is invariably hispid. While the size and dcnsity of calycal spines vary within populations, they are generally similar to those on the zooid's stalk.

The tentacles are extended directly above the calyx parallel to the stalk (Fig. 1c) rather than

FIGURE 3. *Pedicellina whiteleggii* calyces. **a**. contracted, fixed, female calyx (from Rose Bay, NSW) in side view. **b**. contracted, live, immature calyx (from Aldinga Reef, SA) in side view. **c**. semi-contracted, live, male calyx (from Portobello, NZ) in frontal view. **d**. semi-contracted, live, immature calyx (from Fairlight, NSW) in side view. Scale bar=100 μm in a–d.

TABLE 1. Dimensions of zooidal components of *Pedicellina whiteleggii*. All measurements are given in micrometers.

Dimension	Average (adult)	Observed Range
CALYX HEIGHT (calyx base to tentacular membrane)	600	400–760
CALYX DEPTH (in side view)	500	300–600
CALYX WIDTH (in anterior or posterior view)	350	220–450
TENTACULAR MEMBRANE HEIGHT (region of conspicuous circular musculature)	75	60–85
TENTACLE NUMBER	20–24	16–36
CALYX HEIGHT/STALK LENGTH	1:3	1:2–1:4
STALK LENGTH (stolon to base of calyx)	1400	720–2600
APICAL STALK WIDTH (at calyx)	130	110–180
MID-STALK WIDTH (in middle)	160	120–280
BASAL STALK WIDTH (just above stolon)	240	160–340
STOLON WIDTH	90	60–120
FERTILE SEGMENT LENGTH	400	240–600
STERILE SEGMENT LENGTH	300	100–600
LARVAL HEIGHT (prototroch to apical organ)	150	130–200
LARVAL WIDTH (in side view)	75	60–100

tilted anteriorly as in some other pedicellinid species. The tentacular membrane is high, and in contracted calyces the tentacles appear to be deeply infolded. When living colonies are examined under reflected light, conspicuous pale yellow axial bands glisten on the tentacles. At higher magnification these bands appear to consist of two longitudinal rows of large, oval cells, on the abfrontal surface of each tentacle. (Figs. 1c; 3b; 3c; 3d). These large cells may have a glandular function. This tentacular organisation is an unusual and distinctive feature of *P. whiteleggii* which has not been previously recorded.

The shape and size of the digestive tract and its components vary somewhat with state of anaesthetisation. The mouth leads into a typical wide oral funnel which narrows into a tubular esophagus. The stomach is large, often somewhat triangular in appearance, wider on top than near the base (Fig. 3a). The intestine is a broad cylinder which narrows abruptly at the rectum. The rectum is quite broad, and sometimes widens towards the anus. The anal cone often extends obliquely, but may be folded down horizontally in a contracted calyx or extended up vertically in a fully relaxed animal.

Sexual Reproduction: Sexual reproduction probably occurs year-round. In very mature colonics, 80–90% of calyces have testes or ovaries. Since colony boundaries could not be determined, it was impossible to determine whether colonics are gonochoric or hermaphroditic. Calyces contain gonads of only one sex, and thus appear to be gonochoric, although the possibility of sequential hermaphroditism cannot be excluded. Testes are similar to those of other kamptozoans in appearance and location: large white sacs packed with sperm, lying on either side above the stomach (Fig. 1b). Females havc relatively large

ovaries for a kamptozoan, located in the same position as the testes (Fig. 1c). About 12–16 embryos are clustered in a thin-walled, flexible brood chamber. The embryos seem unusually small and numerous.

The larva is relatively small (Table 1), tall and very narrow in frontal and side view (Figs. 1d; 4a; 4b). The surface of the swimming larva is densely coated with particles of apparently external origin which appear beige under reflected light and dark under transmitted light. Particles sometimes cover even larvae which are still retained in the brood chamber. Perhaps sticky secrections coat the larval surface, attracting and retaining particles. The outline of the prototroch is roughly circular when viewed from below. The larval foot and frontal organ are highly reduced or absent. As in other kamptozoans, the larval body is quite contractile.

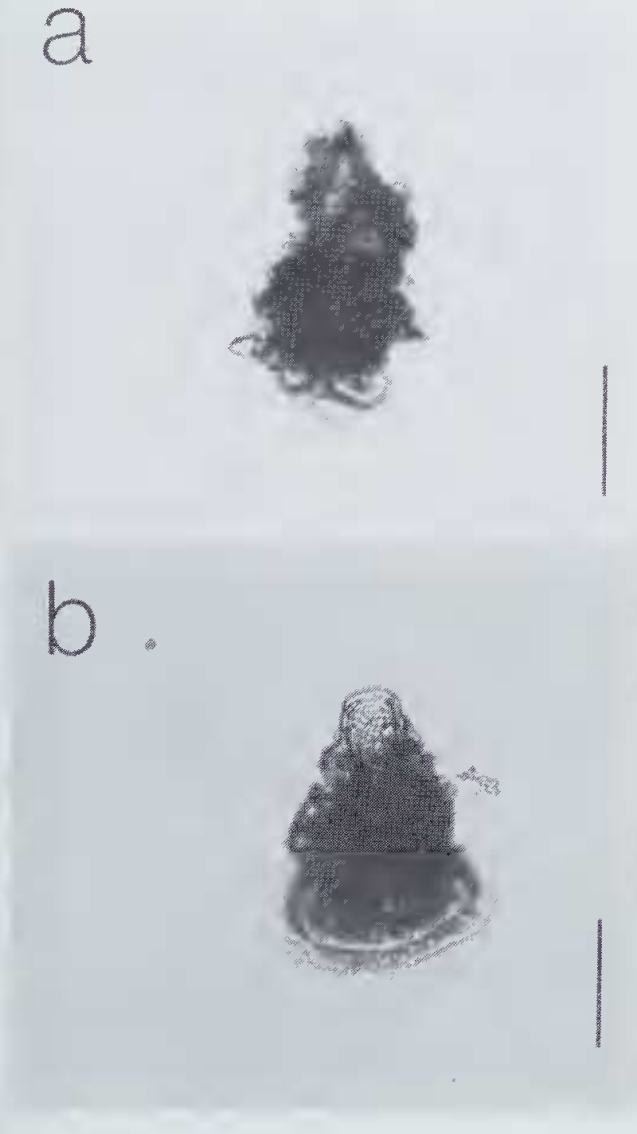

FIGURE 4. *Pedicellina whiteleggii* larvae. **a**. larva (from Portobello, NZ), probably in frontal view. **b**. larva (from Aldinga, SA), probably in side view. Scale bar=100 µm in a and b.

The form of the larva in *Pedicellina whiteleggii* is very distinctive and differs from that of other pedicellinids in which the larva is known. In both *P. cernua* and *P. nutans* the larva is much larger and much wider in side view, and has a well-developed foot and frontal organ (Nielsen 1971). While the larva of *P. whiteleggii* differs markedly from those of some of its congeners, it bears a striking resemblance in its proportions and in the dense particulate covering to the 'type A' larva described for the barentsiid *Barentsia gracilis* from European waters (Nielsen 1971). The *B. gracilis* 'type A' larva also lacks a foot and has a reduced frontal organ.

Newly settled larvae are found on or near adult colonies, suggesting that in this species, as in many or all other kamptozoans, larval settlement is gregarious.

Habitat

Colonies of *Pedicellina whiteleggii* generally occur on living substrata, including algal holdfasts, sponges, hydroids, serpulid polychaete tubes, oyster shells, erect and encrusting bryozoa, and ascidians. The most common hosts seem to be serpulids, encrusting bryozoans, and solitary ascidians. Occasionally, colonies may also grow directly on protected rock surfaces.

This pedicellinid occurs in sheltered places, such as under stones or in deep overhangs, and grows in fouling communities of hydroids, ascidians, and bryozoans. The material examined for this study was collected primarily from the low intertidal zone, with only a few specimens collected subtidally at a few meters depth. This species' distribution may well extend into far deeper water; it should be sought by examination of appropriate substrata collected by SCUBA or dredging.

Distribution

South Australia (Gulf St. Vincent; Yorke Peninsula), New South Wales (Port Jackson; Port Stephens; Port Kembla), Victoria (Lady Julia Percy Island; Little Henty Reef), and New Zealand (Goat Island Bay; Pukerua Bay; Otago Peninsula).

Pedicellina whiteleggii *and its synonyms*

Three reports of pedicellinids from New South Wales and Victoria roughly match the description of *P. whiteleggii*, but the animals are not well described or figured in these texts. MacGillivray (1887) merely noted *Pedicellina sp.* from Port Phillip Heads without providing descriptive information or a figure; but since *P. whiteleggii* is

common at that locality, his report may well be of this species. Whitelegge (1889) listed *Pedicellina cernua* from Sydney Harbour, again without a description or figure, but Johnston & Walker (1917) synonymised his material with *P. whiteleggii*. Stach (1937) identified *P. whiteleggii* from Lady Julia Percy Island off the Victorian coast, and since Johnston & Angel (1940) examined other collections he had made and found his identifications of *P. whiteleggii* correct, I also infer that his material was indeed *P. whiteleggii*.

Ryland (1965) described a new species, *Pedicellina hispida*, from New Zealand, based on three colonies growing on brachiopods in Otago Harbour, New Zealand. Examination of the types of *P. hispida* revealed that it closely matches *P. whiteleggii*: a narrow stolon with inconspicuous septa, hispid stalk and calyx, somewhat asymmetrical calyx with a high tentacular membrane. The sizes and proportions of the zooids also agree with those of *P. whiteleggii*. Live colonies I collected from Otago Harbour were clearly the same as Ryland's *P. hispida* based on zooid structure and calyx morphology. In the fresh material, I noted the rows of large tentacular cells glistening yellow under reflected light, and the tall, particle-covered larva, both characteristic of *P. whiteleggii*. These traits, taken together, justify the synonymy of Ryland's *P. hispida* from New Zealand with *P. whiteleggii*. Gordon (1972) identified a kamptozoan from the North Island of New Zealand as *P. hispida* Ryland. Based on the figure, this kamptozoan was probably also *P. whiteleggii*.

Ryland (1965) also identified colonies from Europe as *P. hispida*, but the calyces in these colonies are glabrous, while those of *P. whiteleggii* are always hispid. The tentacle and larval structure of the European colonies is not known, and so their status is uncertain. Because of this uncertainty and because their localities are so distant from Australia and New Zealand, I have excluded the European specimens of *P. hispida* from the list of synonyms of *P. whiteleggii*.

In 1940, Johnston & Angel synonymised *P. whiteleggii* Johnston & Walker with *P. hirsuta* Jullien. This decision reflected a general trend then to consider all the world's pedicellinids as variations of one species, *Pedicellina cernua* Pallas. Cori (1936) suggested that *P. whiteleggii* Johnston & Walker might be *P. cernua var. hirsuta*, described by Jullien (1891) as *P. hirsuta* from Tierra del Fuego. Although Cori had apparently never seen either Jullien's or Johnston's material, Johnston & Angel (1940) were nevertheless swayed by Cori's authoritative opinion. While they did not believe *P. whiteleggii* was a variety of *P. cernua*, they compromised by synonymizing it with *P. hirsuta*. Jullien's (1891) description of *P. hirsuta* is sketchy and there are no illustrations. The type material (Muséum National d'Histoire Naturelle, Paris) consists of five dried zooids on natural substratum (Bry–2177) and a slide mount of five other zooids (Bry–39), of which four are recently budded, tiny zooids at the stolon tip. My examination of this type material suggested that this species, while resembling *P. whiteleggii* in general shape and in the hispid stalk and calyx, is distinct from it. Based on these ten poorly preserved zooids, *P. hirsuta* has a wider stolon that is hispid in places, which contrasts with the narrow, glabrous stolon of *P. whiteleggii*. The stalk tapers less in *P. hirsuta* than in *P. whiteleggii*, and the spines on the *P. hirsuta* types are longer and denser than is typical for *P. whiteleggii*. Most conclusively, the tentacles of the type specimens did not contain the conspicuous large cells found in *P. whiteleggii*. The larval form of *P. hirsuta* remains unknown, because the only sexual mature zooids in the type specimens were male. Since there is no evidence for synonymy with *P. hirsuta* Jullien, *P. whiteleggii* now reverts back to its original 1917 name.

Other pedicellinids from Australia and New Zealand

***Pedicellina compacta* Harmer, 1915**: This species was reported from the Great Barrier Reef by Hastings (1932). Her material (BM 1932.4.20.93) and additional colonies I collected in Rowes Bay, Townsville, Queensland (MTQ G21264) are certainly referable to Harmer's *P. compacta* (BM 1916.8.23.33–34) from the Aru Islands (Indonesia). *P. compacta* apparently replaces *P. whiteleggii* as the ubiquitous coastal species in tropical and sub-tropical waters. *P. compacta* has much smaller zooids than *P. whiteleggii*, with total zooid height (stalk and calyx together) averaging 600–800 μm. The stolon is extremely narrow (30–40 μm) and the stolonic septa are much more conspicuous than in *P. whiteleggii*. The stalk tapers much less between base and apex, and is proportionately shorter, typically one to two times as long as the calyx is high. The stalk is very muscular and mobile. The proportionately big calyx (but still only about 300 μm high!) is narrower in side view than in *P. whiteleggii*; it is not as compressed laterally. The calyx and tentacles show a slight anterior tilt

absent in *P. whiteleggii*, and there are only about 12–16 tentacles. The calyx and stalk are covered by filiform, cylindrical, extremely long spines that are completely different from the shorter, thicker, hook–like spines of *P. whiteleggii*.

***Pedicellina pyriformis* Ryland, 1965**: This exquisite species forms the tallest and densest colonies known for any pedicellinid. It was described by Ryland (1965) from the Otago Peninsula. I have examined his material (PML reference collection; OM Iv2008–9/A.64:7–8) as well as a colony collected by K. Gowlett-Holmes (SAM PH 0008) from Tasmania. The stolon is very much wider than in *P. whiteleggii* and is completely non–septate. The stalk is listed by Ryland as being about 2 mm long, but a colony from Otago deposited at PML after his study was completed has stalks reaching an astonishing 5–6 mm. The stalk tapers only very slightly from base to apex, and both calyx and stalk are glabrous. The triangular calyx is much less laterally compressed than in *P. whiteleggii*, and is not asymmetrical in side view. The calyx is typically 600–700 µm high, but in some cases attains a height of 1 mm. The gut is also distinctive: the stomach is compact and triangular, and the intestine and the rectum are long and narrow, the latter extending within an anal cone high into the tentacular crown. The gut has empty spaces around it rather than filling the calyx as in most other pedicellinid species.

***Pedicellina grandis* Ryland, 1965**: This species was described from one colony from Otago Harbour. This colony (PML reference collection; OM A.64:6) resembles *P. whiteleggii* in general form. The stolon is narrow and the septa inconspicuous; the stalk and calyx are hispid. The main difference between *P. grandis* and *P. whiteleggii* appears to be quantitative: some *P. grandis* zooids have considerably longer stalks than do *P. whiteleggii* zooids. Ryland (1965) also noted that the tentacles in semi–contracted calyces form a distinctive conical cap, but this trait appears to vary with the state of zooidal relaxation. Further examination of the tentacle structure and larval form of this species may reveal further distinguishing features which separate the two species, or, on the other hand, that *P. grandis* is synonymous with *P. whiteleggii*, and that its longer stalks can be attributed to habitat or age differences.

***Pedicellina pernae* Ryland, 1965**: This species from Otago is distinguished from *P. whiteleggii* by its somewhat smaller size and a glabrous or only sparsely hispid calyx. Ryland (1965) noted that the calyx was more asymmetrical than that of *P. hispida* (=*P. whiteleggii*), but my examination of the types (PML reference collection; OM Iv2011/A.64:10) revealed that the calyx shape falls within the range of variation of *P. whiteleggii*. Ryland (1965) himself noted that this species lacks really distinctive features. Collection of living material and examination of tentacle structure and larval form could reveal whether this is indeed a different species than *P. whiteleggii*.

***Pedicellina cernua* (Pallas, 1774)**: This cosmopolitan species occurs mainly in bays and harbours. Kirkpatrick (1890) found this species in Port Phillip, Victoria. Chittleborough (1952) reported *P. cernua* from a community of primarily introduced species at Port Adelaide and Outer Harbour, South Australia, and it is probably present in other harbours in Australia and New Zealand. Kirkpatrick's (BM 1888.5.17.24) and especially Chittleborough's material (SAM L713–718) have many features which distinguish the cosmopolitan *P. cernua* from the indigent *P. whiteleggii*. The stolonic septa in *P. cernua* are more clearly visible. The stalk is narrower and tapers more gradually from base to apex. The stalk is hispid, and the spines longer than in *P. whiteleggii*, although this feature is variable. The calyx of *P. cernua* is wider in side view, almost as wide as high, and its aboral bulge and consequent asymmetry are more pronounced. The tentacles in *P. cernua* are tilted anteriorly. The tentacles lack axial rows of large cells, although there is dark green granular pigmentation in the tentacles of some zooids. The tentacular membrane is not so high as in *P. whiteleggii*. A more striking difference is the consistent absence of spines from the calyx. The rectum in *P. cernua* generally appears narrower and extends higher into the tentacular crown than in *P. whiteleggii*. The brood chamber of *P. cernua* is lobulate, while that of *P. whiteleggii* is not. As already discussed, the larva of *P. cernua* differs from that of *P. whiteleggii* in being larger, wider in side view, in having a well–developed foot and frontal organ, and in lacking a dense particulate covering (Nielsen 1971).

Discussion

Knowledge of pedicellinids from Australia and New Zealand is rather limited. This is certainly not because the animals are rare or hard to find; only a few hours in the field turned up many colonies at every site I visited.

The diversity of Australian and New Zealand pedicellinids is low. There appears to be one

ubiquitous coastal pedicellinid (*P. whiteleggii*) in colder waters and another (*P. compacta*) in warmer regions, one cosmopolitan species in harbours (*P. cernua*), and one other distinctive species (*P. pyriformis*) in southern areas. Other unreported and perhaps undescribed species will surely be found in unexplored habitats (e.g. deeper water) or unsurveyed regions (e.g. Western Australia). In Northern Europe, which has been much better surveyed for kamptozoans, there is also a low diversity of pedicellinids; only one or two common species and a few rare ones. It is difficult to compare the species diversity of pedicellinids from Australia with other regions, since the pedicellinid fauna of most parts of the world has not been characterised.

The distributions of the pedicellinids found in Australia and New Zealand seem fairly large. *Pedicellina pyriformis*, known only from Otago and Tasmania, appears to have the most limited range, but this rare species may yet be found in other areas. The distribution of *P. whiteleggii* includes much of New Zealand and southern Australia, but its western and southern limits are not known. *P. compacta* is found from Indonesia to Queensland. And *P. cernua* has been reported from all over the world. Only more thorough taxonomic surveys will delineate these ranges more adequately.

The taxonomy of pedicellinids (and of tiny, soft–bodied creatures in general) always poses challenges because of the apparent paucity of morphological characters. Historically, kamptozoan taxonomy has been based on adult traits. Larval form has been largely ignored (but see Nielsen 1971), although since all kamptozoans brood, and most are reproductive year–round, larvae are usually easy to obtain. Larvae can also be examined in well–preserved museum specimens. In this study, a distinctive larval form enabled museum and the field material in Australia and New Zealand to be united under one name, and helped to separate *Pedicellina whiteleggii* from *P. cernua*. In the future, pedicellinid taxonomy would be strengthened by inclusion of larval traits in species descriptions.

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